Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Amendment of Parts 2 and 15 of the	)	
Commission's Rules Regarding	)	ET Docket No. 96-8
Spread Spectrum Transmitters	)	

COMMENTS

Tadiran Telecommunications, Inc. ("Tadiran"), a division of Tadiran Electronic Industries, Inc., submits these comments in response to the Notice of Proposed Rulemaking in the above-captioned proceeding, 11 FCC Rcd 3068 ("NPRM"). Tadiran's comments are limited to the subjects of the number of hopping channels in the 2450 MHz band (NPRM, para. 18-34) and frequency hopping coordination (NPRM, para. 43).

The number of hopping channels required in the 2400-2483 MHz band should be decreased so that the 2450-2483 MHz upper part of the band, which is more subject to interference, may be avoided.

Coordination should be permitted so long as coordinated transmitters are isolated from one another by distance or antenna directivity, or the number of coordinated transmitters is small.

Tadiran's Interest

Tadiran is one of the largest electronics manufacturers in Israel and a leading exporter to over 50 countries worldwide, including the United States. Its products cover both wireline and wireless telecommunications, military electronics systems, software, batteries and home appliances. It is a major supplier of telecommunications systems to Bezeq, Israel's national telephone company, and other PTTs around the world. A Tadiran subsidiary, jointly with General Dynamics, supplies the new SINCGARS frequency hopping tactical radio system to the U.S. Army.

Tadiran Telecommunications has developed its MultiGain Wireless system to support wireless local loop applications. This is a frequency hopping spread spectrum system that is either being tested by potential customers or purchased and installed by operating telephone companies in nearly twenty countries throughout the world. In the United States, two major telephone companies have installed systems to evaluate. The MultiGain Wireless system is intended to operate in the 2400-2483 MHz band in the United States. In the course of developing this product, Tadiran has learned some important lessons about spectral efficiency and interference in this band, and seeks this opportunity to share these lessons.

Hopping Frequencies in the 2450 MHz Band

The Commission has proposed to accept Spectralink's proposal to reduce the number of hopping frequencies in the 902-928 MHz band from 50 to 25, but it has proposed to reject Symbol's request to reduce the number of hopping frequencies in the 2450 MHz band from 75 to 20. One justification for accepting the Spectralink proposal is the recent allocation of spectrum within the 902-928 MHz band for vehicle monitoring service, so that frequency hopping devices may avoid the vehicle monitoring bands. NPRM, para. 31. We note, however, that there is a similar factor affecting the 2450 MHz band. The 2450 MHz band is allocated, in part, for licensed services. Both broadcasters and private microwave licensees operate high power licensed transmitters in the 2450-2483 MHz part of the band. See Sections 74.602 and 94.65(e) of the Commission's Rules.

Early installations of MultiGain Wireless systems have shown relatively high interference levels in the upper part of the 2450 MHz band. Tadiran engaged Comsearch to make spectral occupancy measurements of the 2400-2483 MHz band in several location in the country. See Figures 1-6 attached, which show typical data taken in Denver (Figures 1, 2) and in New Jersey (Figures 3-6). They show interfering signals present in the 2400-2483 MHz band. Most of the interfering signals were found in the higher part of the band, above about 2450 MHz, but interference below 2450 MHz has been seen also..

For these reasons, we believe the Commission should decrease the required number of hops in the 2400-2483 MHz band so that the interference above 2450 MHz can be avoided. We specifically propose that a minimum of 35 hopping frequencies, rather than 75, be required. As with the 902-928 MHz proposal, such use should be limited to equipment with wide bandwidths, since narrow bandwidth equipment can more easily avoid interference. For the 2400-2483 MHz band, the reduction in hopping frequencies should be limited to devices that occupy 500 kHz or more per hop.

Similarly, as with the 902-928 MHz proposal, the average time occupancy should be reduced to 0.4 seconds in any 10 second period, and the power limit should be reduced to 500 milliwatts. See NPRM at para. 31-33.

Coordination Between Frequency Hopping Transmitters

As noted in the NPRM, coordination of hopping frequencies between transmitters has not normally been permitted.[1] Coordination in the frequency domain has been prohibited because it would permit a group of coordinated transmitters to entirely occupy a frequency band. See NPRM at footnote 56. However, unlike the extreme case cited in footnote 56, coordination should generally serve the public interest by promoting more efficient use of the spectrum and minimizing interference. By minimizing interference among the coordinated transmitters, coordination decreases the retransmissions that would be needed when interference does occur. These retransmissions would create more interference than would occur if no retransmissions were needed. Other nearby users would benefit from reduced interference provided by coordination even though these other users were not themselves coordinated. Consequently, the Commission must find a middle ground that prohibits the extreme case of one group of coordinated transmitters monopolizing the band, but promotes the

[1]The NPRM does not define "coordination" but we understand it as coordination in the frequency domain, to mean the automatic control of frequency hopping transmitters, including choice of the hopping frequencies and relative channel or frequency shift of transmitters within the hopset, so as to assure that transmitters are never transmitting on the same frequency at the same time. We also understand that transmitters from the same manufacturer may employ the same hopset sequence, so long as there is no automatic control that assures each transmitter will hop at a different relative frequency shift within the hopset.

spectral efficiency that coordination can provide.

Some measure of isolation between coordinated transmitters can promote spectral efficiency while not penalizing other users. We are aware of at least two such isolation approaches, which we believe the Commission should permit. There may be other isolation approaches as well. In addition, coordination among a small number of non-isolated transmitters should be permitted.

Coordinated transmitters can be isolated from one another by means of physical separation, or by antenna directivity. These methods of isolation also isolate other users from some or all of the coordinated transmitters, so other users are not penalized by receiving more interference than otherwise. Other users receive interference from only one or perhaps two of the coordinated transmitters.

Isolation by Means of Separation

In the past, most frequency hopping transmitters have been authorized subject to the following condition in the grant of equipment authorization:

> This grant is issued subject to the condition that the transmitter covered hereunder will not be marketed with any capability to coordinate its hopping sequence with the hopping sequence of any other transmitters, or vice versa, for the purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters. NPRM at footnote 55.

However, the Commission has authorized at least two frequency hopping transmitters with the following condition which isolates one transmitter from another:

> This grant is issued subject to the condition that the transmitter covered hereunder will not be marketed with any capability to coordinate its hopping sequence with the hopping sequence of any other transmitters, or vice versa, for the purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters, unless an automatic lockout is provided such that a transmitter will not operate in a coordinated manner if a signal is detected from another coordinated transmitter at a field strength greater then 50 mV/m.

This language is found on the equipment authorization grants for FCC ID# IYGRCU100 and IYGPTX100, both manufactured by Spectralink Corp, granted May 19, 1992.

This 50 mV/m field strength level that was imposed on the Spectralink equipment is the limit specified in Section 15.249 of the FCC Rules, which applies to non-spread spectrum transmitters in the 915 and 2450 MHz bands. While the condition does not restrict the power level of the frequency hopping transmitters to be as low as Section 15.249 equipment, it does assure that the hopping transmitters will have to be separated quite far from one another if they operate at the allowed 1 watt power level. This distance separation assures that at any location, other Part 15 users will see only a single hopping transmitter, rather than the example of all 50 transmitters that could fully occupy the 915 MHz band (NPRM at footnote 56.)

The Commission's reason for prohibiting the coordination of hopping frequencies is to prevent an operator from monopolizing the band in a given location. NPRM at para. 43. The 50 mV/m field strength limit at each transmitter location serves the same purpose as an outright prohibition. It guarantees that signal levels from coordinated hopping transmitters will be low enough, since transmitters will be separated far enough apart, that other users would not suffer unreasonable levels of interference.

Consequently, operation of coordinated frequency hopping transmitters should be permitted so long as the field strength of any one transmitter at any other transmitter location does not exceed 50 mV/m.

In granting the Spectralink authorizations, the Commission required an interlock circuit that would measure the field strength from all other coordinated transmitters, and shut itself down if the 50 mV/m level were exceeded. While such an interlock is one way to assure compliance, a simpler and less expensive method would be to require physical separation of transmitters. For example, assuming half-wave dipole antennas and 1 watt output power, a field strength of 50 mV/m occurs at a distance of 140 meters from the transmitter. We ask the Commission to impose such a separation limit as an alternative to interlock circuitry.

Isolation by Means of Antenna Directivity

Tadiran's MultiGain Wireless system employs six radios and six 60 degree sector antennas at a base station. The hopping sequences of the six radios are coordinated with one another to eliminate interference between one another. This system does not increase the likelihood of interference into other users who happen to be nearby, because these other users would be likely to receive interference from only one sector or perhaps two sectors. The remaining sectors would present their sidelobe or backlobe emissions to the other users, and these signal levels would be diminished by about 25 dB compared to the mainlobe emissions. The isolation created by the sector beam antenna directivity provides isolation to other nearby users as well as to stations in our system. It serves the same purpose as the 50 mV/m limit that was previously permitted, namely, it protects other nearby users from receiving interference from more than one or two coordinated transmitters.

Consequently, we ask the Commission to adopt rules that permit co-located frequency hopping transmitters to employ coordination, so long as they also use directional sector beam antennas rather than omni-directional antennas. "N" transmitters should be allowed to coordinate so long as they employ antenna beamwidths of 360/N degrees.

Coordination Among a Small Number of Transmitters

The Commission should also permit coordination among a small number of frequency hopping transmitters, without any isolation among one another. The extreme case of 50 transmitters hopping among 50 frequencies may unfairly monopolize the spectrum, but 5 transmitters hopping among 50 frequencies should promote spectral efficiency without unduly harming other users. We propose specifically that a number of radios up to 10% of the required number of hopping frequencies be permitted to coordinate their hopping sequences with one another. This should leave plenty of spare, uncoordinated capacity for other users to share without interference.

Conclusion

The minimum number of hopping frequencies in the 2400-2483 MHz band should be reduced from 75 to 35, with appropriate changes in other parameters, to allow frequency hopping devices to avoid high levels of interference in the 2450-2483 MHz range.

The Commission should permit the coordination of frequency hopping transmitters so long as (1) the field strength of any one at any other transmitter does not exceed 50 mV/m, or (2) the transmitters are co-located and employ directional sector beam antennas, or (3) the number of coordinated transmitters does not exceed the number of hopping frequencies divided by 10.

Respectfully submitted,

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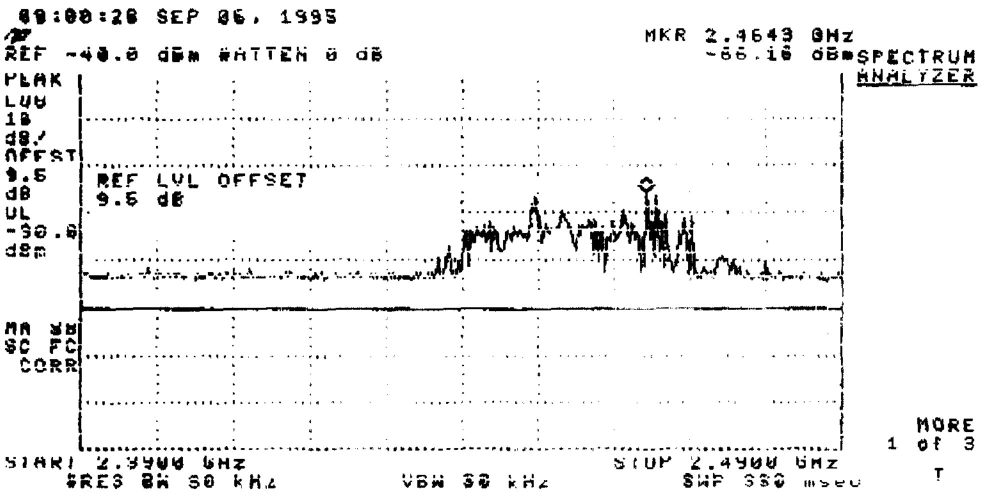


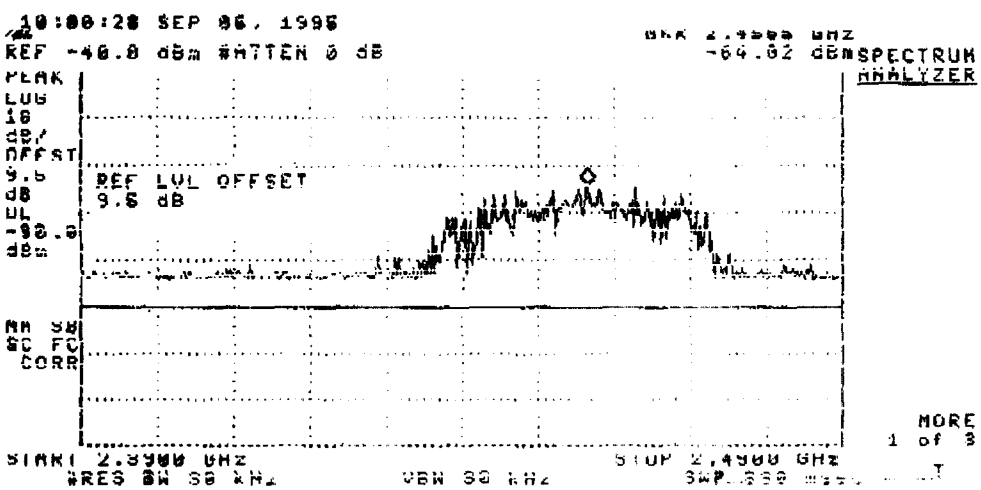
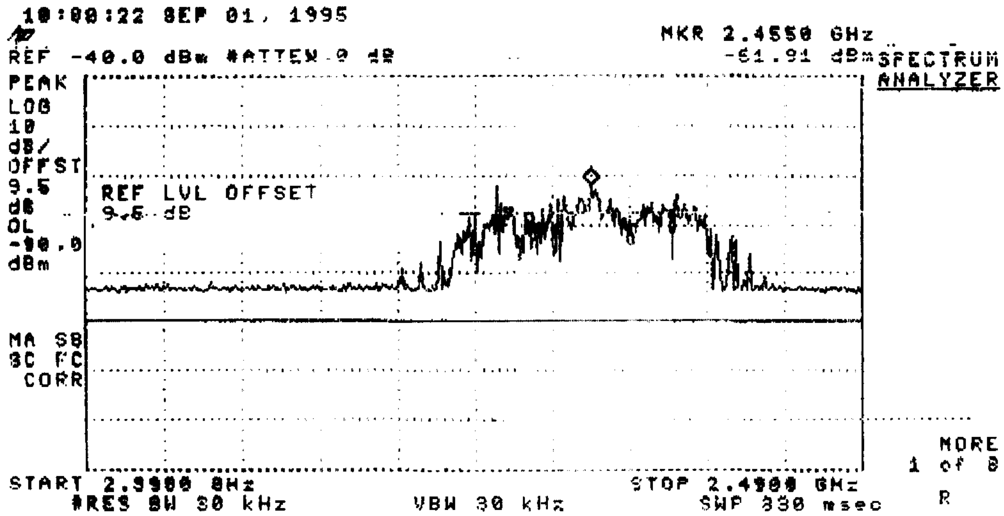
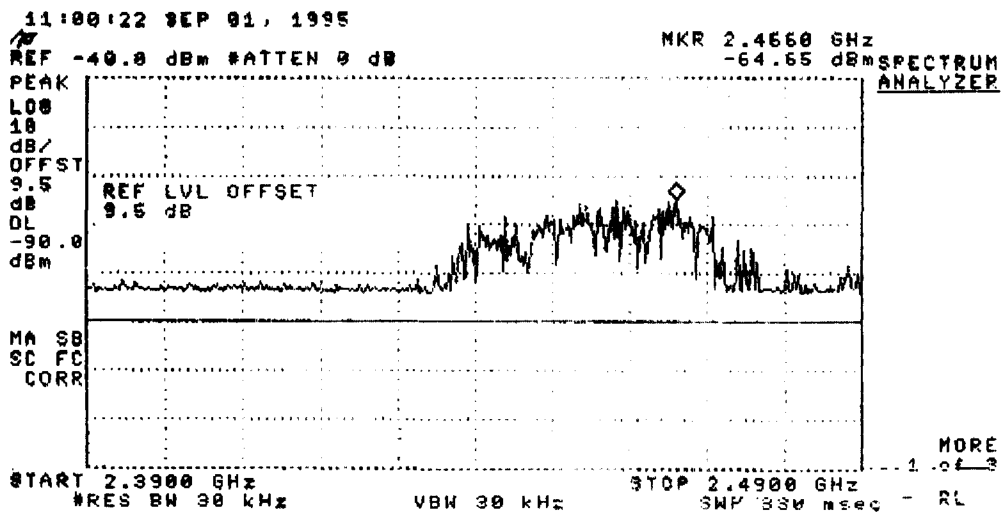


Figure 1

11:00:28 SEP 06, 1995

MKR 2.4458 GHz


10:00:22 SEP 01, 1995
MKR 2.4550 GHz
REF -40.0 dBm #ATTEN 0 dB
-61.91 dBm
SPECTRUM ANALYZER
PEAK
LOG
10
dB/
OFFST
9.5
dB
DL
-90.0
dBm
REF LVL OFFSET
9.5 dB
MA SB
SC FC
CORR
MORE
1 of 3
START 2.3900 GHz
STOP 2.4900 GHz
#RES BW 30 kHz
VBW 30 kHz
SWP 330 msec


11:00:22 SEP 01, 1995
MKR 2.4660 GHz
REF -40.0 dBm #ATTEN 0 dB
-64.65 dBm
SPECTRUM ANALYZER
PEAK
LOG
10
dB/
OFFST
9.5
dB
DL
-90.0
dBm
REF LVL OFFSET
9.5 dB
MA SB
SC FC
CORR
MORE
1 of 3
START 2.3900 GHz
STOP 2.4900 GHz
#RES BW 30 kHz
VBW 30 kHz
SWP 330 msec

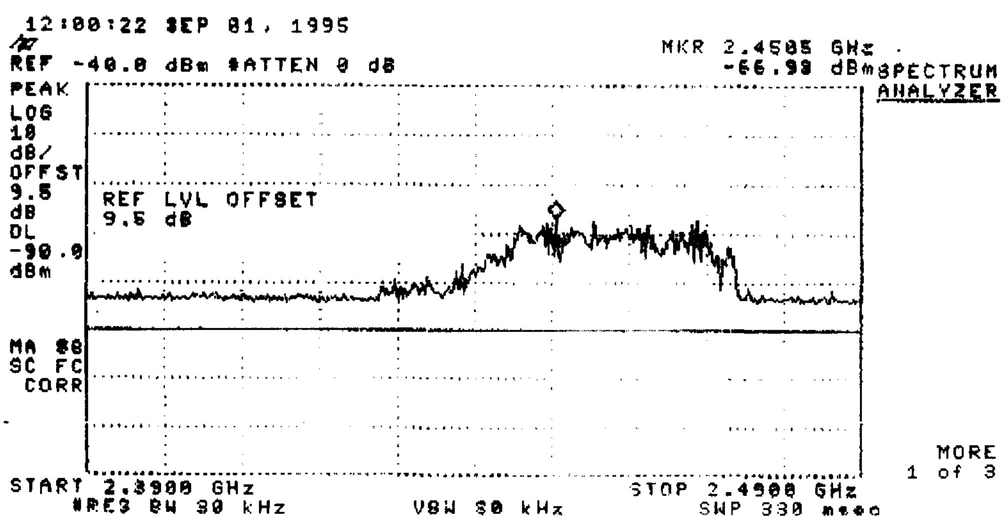

12:00:22 SEP 01, 1995
MKR 2.4505 GHz
REF -40.0 dBm #ATTEN 0 dB
-66.99 dBm
SPECTRUM ANALYZER
PEAK
LOG
10
dB/
OFFST
9.5
dB
DL
-90.0
dBm
REF LVL OFFSET
9.5 dB
MA SB
SC FC
CORR
MORE
1 of 3
START 2.3900 GHz
STOP 2.4900 GHz
#RES BW 30 kHz
VBW 30 kHz
SWP 330 msec

Figure 2


13:00:22 SEP 01, 1995
MKR 2.4460 GHz
REF -40.0 dBm
SPECTRUM

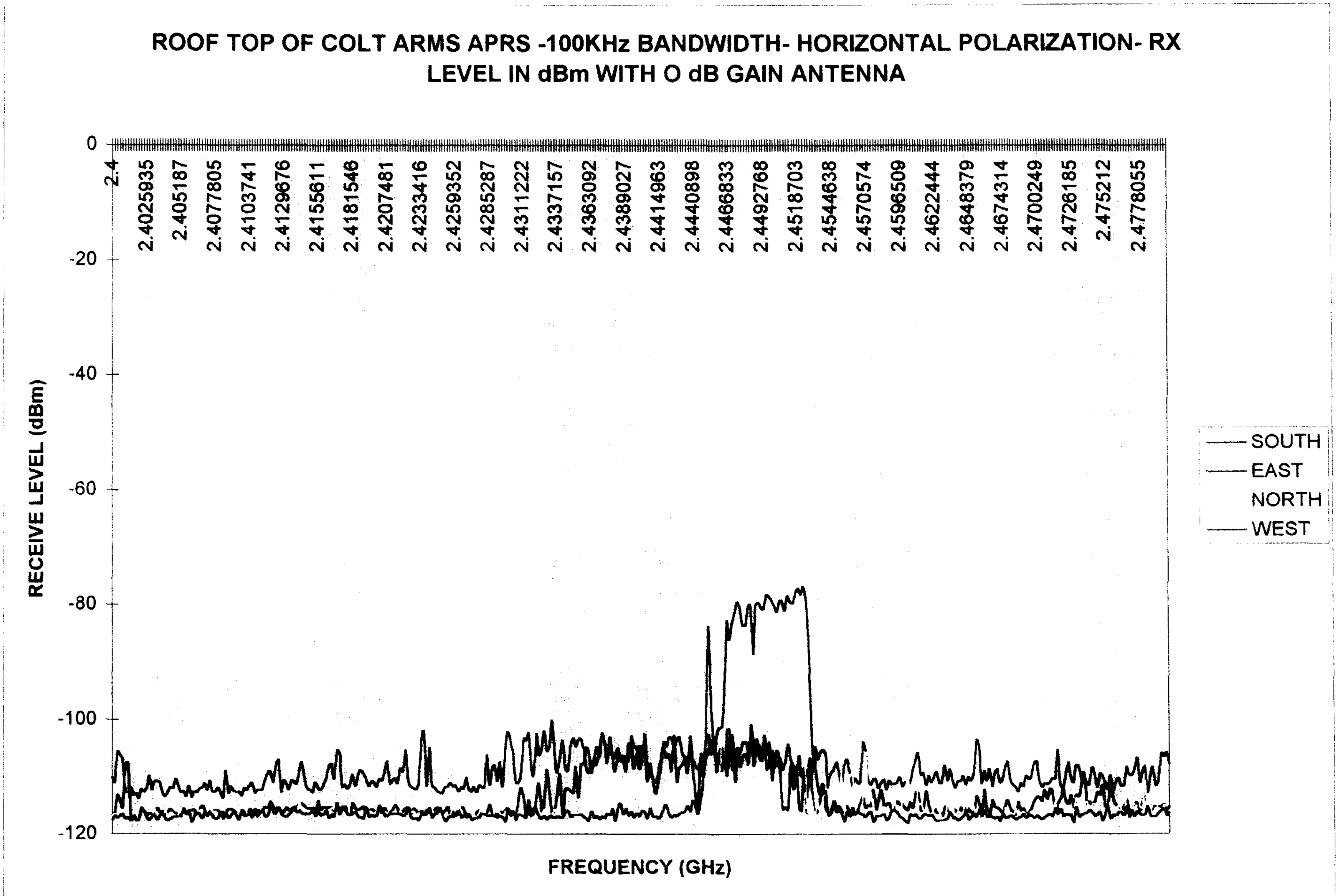

ROOF TOP OF COLT ARMS APRS -100KHz BANDWIDTH- HORIZONTAL POLARIZATION- RX LEVEL IN dBm WITH O dB GAIN ANTENNA
RECEIVE LEVEL (dBm)
0
-20
-40
-60
-80
-100
-120
2.4
2.4025935
2.405187
2.4077805
2.4103741
2.4129676
2.4155611
2.4181546
2.4207481
2.4233416
2.4259352
2.4285287
2.4311222
2.4337157
2.4363092
2.4389027
2.4414963
2.4440898
2.4466833
2.4492768
2.4518703
2.4544638
2.4570574
2.4596509
2.4622444
2.4648379
2.4674314
2.4700249
2.4726185
2.475212
2.4778055
FREQUENCY (GHz)
SOUTH
EAST
NORTH
WEST

Figure 3

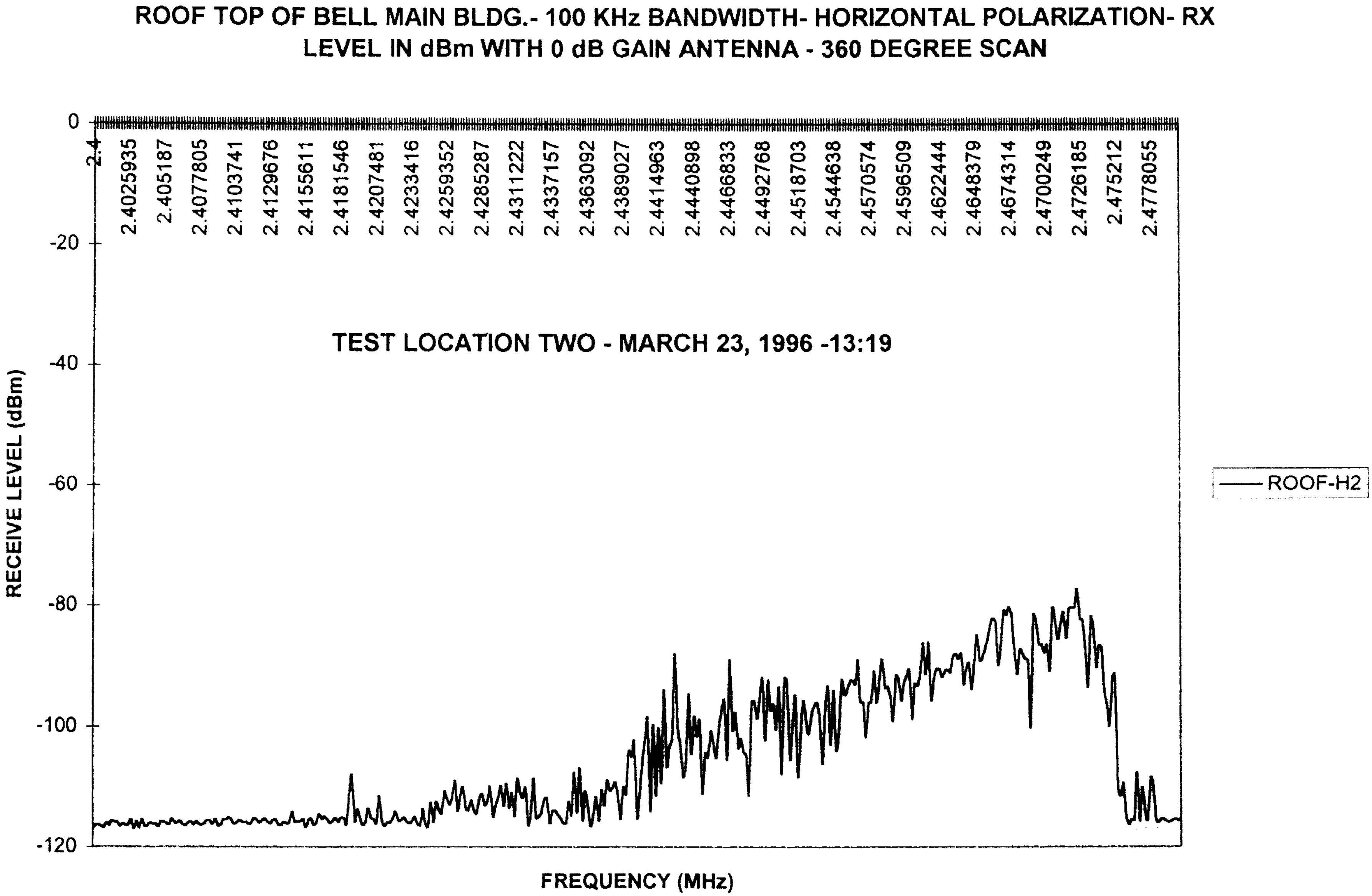

ROOF TOP OF BELL MAIN BLDG.- 100 KHz BANDWIDTH- HORIZONTAL POLARIZATION- RX LEVEL IN dBm WITH 0 dB GAIN ANTENNA - 360 DEGREE SCAN
TEST LOCATION TWO - MARCH 23, 1996 -13:19
RECEIVE LEVEL (dBm)
0
-20
-40
-60
-80
-100
-120
2.4
2.4025935
2.405187
2.4077805
2.4103741
2.4129676
2.4155611
2.4181546
2.4207481
2.4233416
2.4259352
2.4285287
2.4311222
2.4337157
2.4363092
2.4389027
2.4414963
2.4440898
2.4466833
2.4492768
2.4518703
2.4544638
2.4570574
2.4596509
2.4622444
2.4648379
2.4674314
2.4700249
2.4726185
2.475212
2.4778055
FREQUENCY (MHz)
ROOF-H2

Figure 4

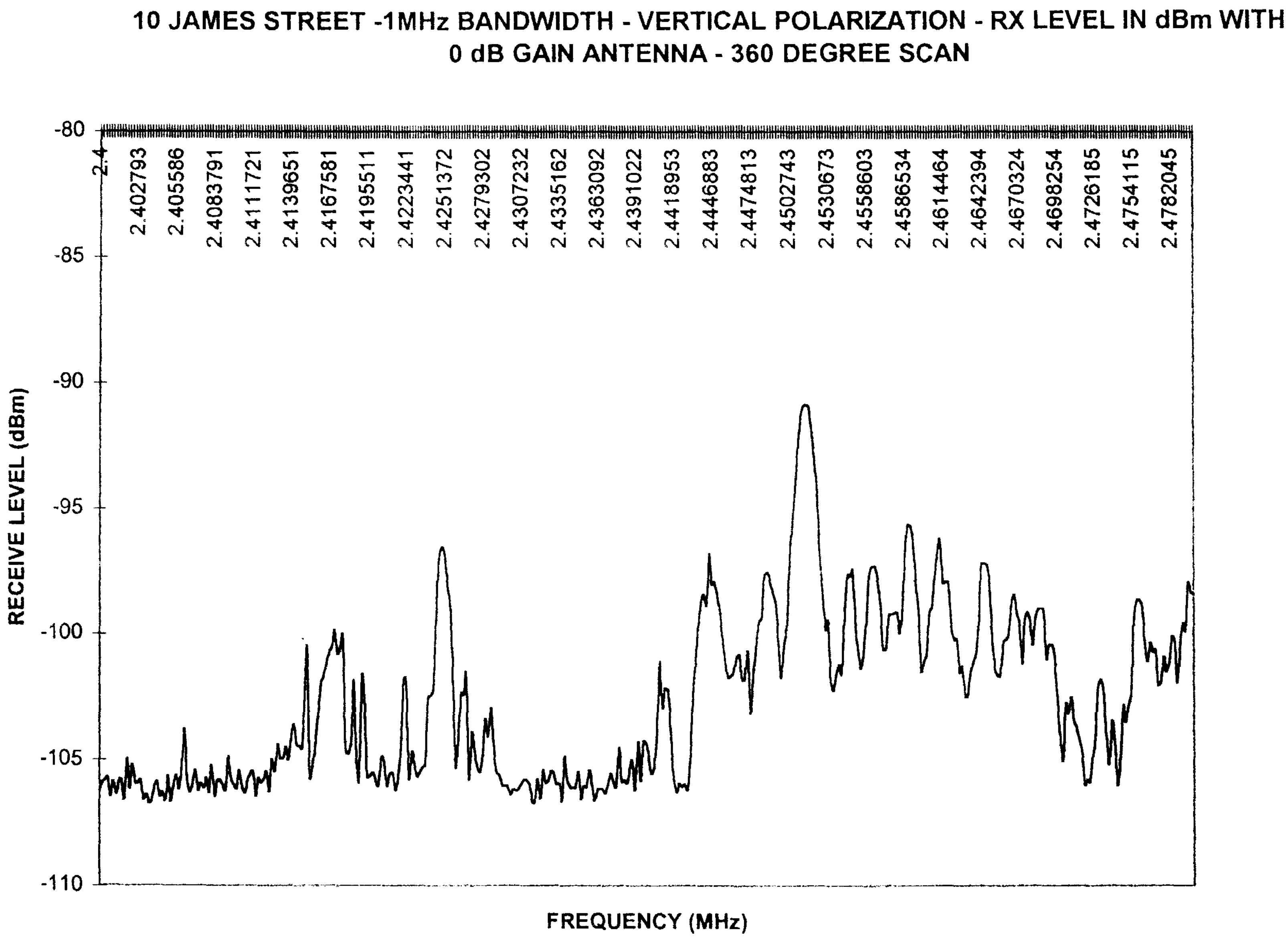

10 JAMES STREET -1MHz BANDWIDTH - VERTICAL POLARIZATION - RX LEVEL IN dBm WITH
0 dB GAIN ANTENNA - 360 DEGREE SCAN
RECEIVE LEVEL (dBm)
-80
-85
-90
-95
-100
-105
-110
2.4
2.402793
2.405586
2.4083791
2.4111721
2.4139651
2.4167581
2.4195511
2.4223441
2.4251372
2.4279302
2.4307232
2.4335162
2.4363092
2.4391022
2.4418953
2.4446883
2.4474813
2.4502743
2.4530673
2.4558603
2.4586534
2.4614464
2.4642394
2.4670324
2.4698254
2.4726185
2.4754115
2.4782045
FREQUENCY (MHz)

Figure 5

44 PATTERSON ST. -100 KHz BANDWIDTH- VERTICAL POLARIZATION- RX LEVEL IN dBm WITH O dB GAIN ANTENNA -360 DEGREE SCAN

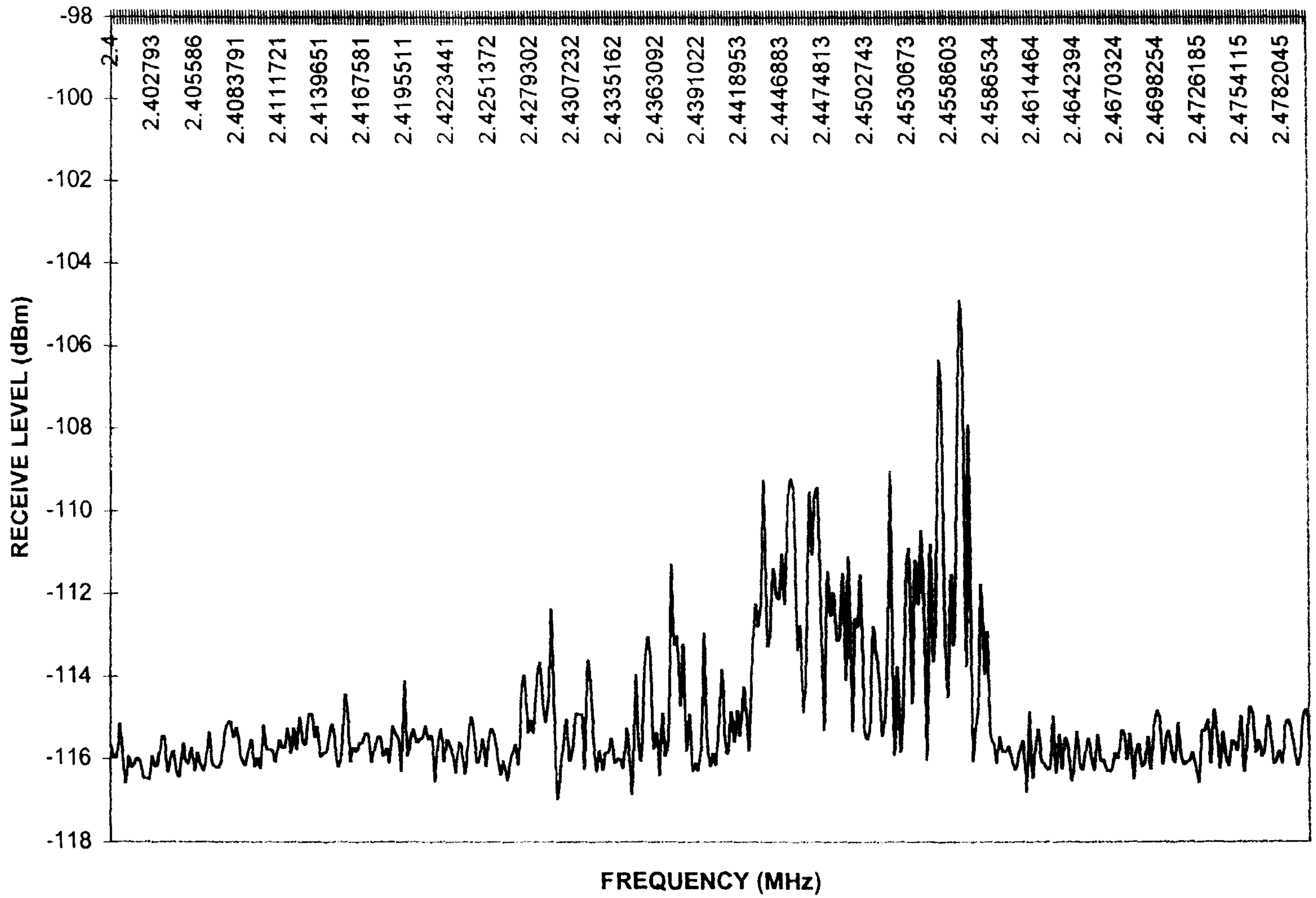


Figure 6